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The relationship between prognostic nutritional index and mortality in geriatric COVID-19 patients

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ABSTRACT

Aims: The aim of this study is to examine the relationship between prognostic nutritional index (PNI) and mortality in geriatric patients who admitted to hospital due to COVID-19.

Methods: In this retrospective cohort study, geriatric patients admitted to the emergency department of a tertiary hospital and hospitalized for COVID-19 were examined. Demographic data, laboratory results, in-hospital mortality status of the patients were recorded. The relationship between PNI values and in-hospital mortality was analyzed.

Results: The study was completed with 316 patients whose data were fully accessible. The mean age of the patients was 77.3±7.9 years and 167 (52.8%) were male. When the cut-off value of PNI level in identifying in-hospital mortality was≤42, the sensitivity was 92.3%, the specificity was 44.9%, and the positive predictive value was 57.5 and the negative predictive value was 87.8

Conclusion: This study demonstrates the prognostic importance of PNI in geriatric COVID-19 patients. Low PNI values were associated with higher in-hospital mortality rate. The use of PNI can be considered an important tool in evaluating the COVID-19 prognosis of elderly patients and developing more individualized treatment strategies.

Keywords: COVID-19, mortality, prognostic nutritional index

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has become a significant crisis affecting life worldwide and straining health systems.[1,2] COVID-19 can be more severe in elderly individuals and patients with comorbidities.[3] Therefore, there is an increasing need for determinants that assess and optimize management strategies for the prognosis of COVID-19 in geriatric patients. Nutritional status is an important factor in terms of disease prognosis and quality of life in elderly patients. Malnutrition has been associated with length of hospital stay, risk of infection, mortality, and morbidity. Current literature data report that malnutrition develops in approximately 50% of all hospitalized patients and in approximately 44% of surgical patients.[4] The likelihood of developing malnutrition has been found to be associated with the length of hospitalization, the severity of the disease, and surgical stress.[5] Furthermore, studies have shown that as the malnutrition process extends, the risk of morbidity and mortality increases.[6]

The prognostic nutritional index (PNI), calculated based on serum albumin levels and lymphocyte count, is an index that evaluates patients' nutritional status and immune functions.[7] Previous studies have revealed the importance of PNI in the prognosis and treatment processes of various diseases.[8] There are also studies on the prognostic significance of PNI in geriatric COVID-19 patients.[9,10] This study aims to assess the prognostic value of PNI in geriatric COVID-19 patients and its relationship with clinical outcomes. This information can contribute to developing more effective and individualized approaches in the treatment of elderly patients with COVID-19 infection.

METHODS

This retrospective cohort study includes geriatric COVID-19 patients who presented to the emergency department and were hospitalized at Şişli Hamidiye Etfal Training and Research Hospital between January 1, 2021, and January 1, 2022. This study has been approved by the Şişli Hamidiye Etfal Ethics Committee,

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and the confidentiality of all patients' data has been protected (Date: 04.04.2023, Decision No: 2289). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.[11]

The patients included in the study consisted of patients aged 65 and over who were diagnosed with COVID-19 and admitted to the hospital.Diagnosis was confirmed based on symptoms, physical examination findings, and real-time reverse transcription-polymerase chain reaction (RT-PCR) tests.[12] The criteria in the Ministry of Health guidelines were used for admission to the hospital. According to these criteria, patients with comorbidities with tachycardia (pulse >125/min), tachypnea (respiratory rate >22/min), hypotension (<90/60 mmHg), or hypoxemia (SpO_2 <93%) were hospitalized.[13] Patients under the age of 65, those with negative RT-PCR test results, and those with a history of malnutrition (cachectic patients, patients with stroke) were excluded from the study. Patients' demographic information, clinical findings, laboratory results, and treatment processes were obtained from hospital records. PNI values were calculated using serum albumin levels and lymphocyte counts recorded at the time of presentation. The PNI formula is as follows: 10 x serum albumin level (g/dL) + 0.005 × lymphocyte count (mm^3).[9] The primary outcome of the study has been determined as the in-hospital mortality rate.

Statistical Analysis

Descriptive criteria were presented as mean and standard deviation, and percentage distribution. The normality of the data distribution was checked with the Kolmogorov-Smirnov test. In the comparison of sociodemographic, clinical, and laboratory findings between deceased and surviving patients, Pearson Chi-Square analysis was used for comparing distributions, and the Student's t-test was used for comparing continuous variables. Upon finding PNI to be significant as a mortality indicator, receiver operating curve (ROC) analysis was performed to determine sensitivity, specificity, and cut-off points, and the area under the curve (AUC) was calculated. In all analyses, results with a p-value <0.05 were considered statistically significant. Variables with a significant relationship as a result of univariate analysis were then analyzed by logistic regression analysis. Statistical analyses were performed using SPSS (IBM Corp., Armonk, NY, USA).

RESULTS

The study was completed with 316 patients who had complete data available. The mean age of the patients was 77.3±7.9, with 167 (52.8%) being male. Patients were divided into two groups as survivor and non-survivor according to their in-hospital mortality status, and their demographic (age, gender), laboratory, and clinical characteristics were compared (**Table 1**). The mean age and the average number of males in the non-survivor group were higher than in the survivor group (p-values were 0.001 and 0.033, respectively). The mean albumin level in the non-survivor group was lower, while no difference was detected between the groups in terms of mean lymphocyte count (p-values were 0.006 and 0.06, respectively). The mean PNI values of the non-survivor group were found to be significantly lower than those of the survivor group (p:0.001).

As a result of the ROC analysis of PNI level in predicting in-hospital mortality among study population, the area under the curve was 0.816 (95% CI 0.769-0.857), the Youden index was 0.528 (p<0.001). When the cut-off value of PNI level in identifying in-hospital mortality is ≤42, the sensitivity is 92.3%, the specificity is 44.9%, and the positive predictive value is 57.5 and the negative predictive value is 87.8 (**Table 2**, **Figure**).

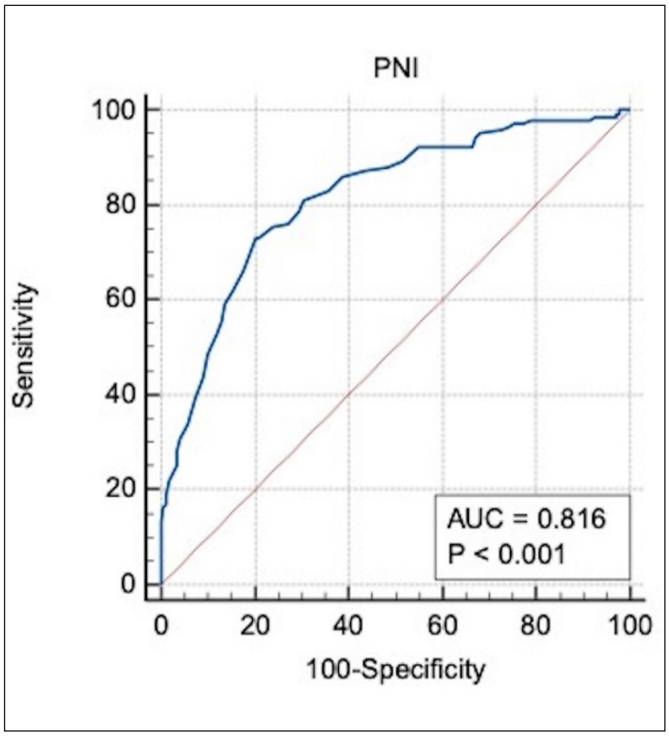

Figure.Receiver operating characteristic curve of the PNI score in predicting in-hospital mortality among patients with COVID-19

As a result of the logistic regression analysis, when adjusted for age, gender, clinical and laboratory characteristics, the probability of being a non-survivor was 16% higher in those with a low PNI score than those with a high score (p:0.001) (**Table 3**).

Table1. General characteristics of the patients included in the study

	Survivor	Non-survivor	Total	p value
	Mean±SD/n-%	Mean±SD/n-%	Mean±SD/n-%	
Gender				0.033
Woman	91 (52.6)	58 (40.6)	149 (47.2)	
Man	82 (47.4)	85 (59.4)	167 (52.8)	
Age, years	75.8±7.6	79±8	77.3±7.9	0.001
Systolic blood pressure (mmHg)	127.2±19.2	127.9±25.8	127.5±22.3	0.789
Diastolic blood pressure (mmHg)	73.9±115	71.6±14.8	72.9±13.1	0.129
Pulse rate (bpm)	83.3±13.7	95.3±20.6	88.3±17.9	0.001
spO_2 (%)	93.3±4.6	88±10	90.9±8	0.001
Temperature (°C)	36.7±0.7	37±0.8	36.8±0.8	0.005
White blood cells (10^3u/L)	7.1±3.7	10±5.3	8.4±4.7	0.001
Neutrophil (10^3/mm^3)	5.7±6.7	8.1±4.9	6.7±6.1	0.001
Lymphocyte (10^3/mm^3)	1.5±2.9	1.0±0.8	1.3±2.2	0.06
Haemoglobin (g/L)	12.4±2	11.9±2.3	12.2±2.1	0.083
Platelet (10^3u/L)	212.1±99.9	233.6±101.9	221.7±101.2	0.059
Urea (mg/dL)	50±28.7	84±63.2	65.1±50.1	0.001
Albumin (g/L)	36.1±4.4	29.4±4.6	33.1±5.6	0.006
AST (IU/L)	39.1±31.5	82.4±363.6	58.4±244.7	0.115
ALT (IU/L)	26.5±22.3	47±190.8	35.7±128.8	0.157
Creatinine (mg/dL)	1.3±3.1	1.7±1.7	1.5±2.6	0.109
Chronic obstructive pulmonary disease	16 (11)	17 (14.8)	33 (12.6)	0.356
Diabetes mellitus	64 (42.7)	38 (33)	102 (38.5)	0.111
Hypertension	84 (55.6)	54 (46.2)	138 (51.5)	0.124
Congestive heart failure	12 (8.3)	23 (20.2)	35 (13.5)	0.005
Coronary artery disease	29 (19.9)	18 (15.9)	47 (18.1)	0.415
Atrial fibrillation	6 (4.1)	3 (2.7)	9 (3.5)	0.537
Chronic renal failure	7 (4.8)	19 (17)	26 (10.1)	0.001
Admission unit				0.001
Inpatient service	159 (89.8)	60 (42)	219 (68.4)	
Intensive care unit	18 (10.2)	83 (58)	101 (31.6)	
Prognostic nutritional index (PNI)	43.6±15.2	34.6±6.7	39.6±12.9	0.001

Table 2. Diagnostic values and cut-off level of the PNI score to predict in-hospital mortality among patients with COVID-19

	AUC	Cut-Off	Sensitivity	Specificity	+LR	-LR	PPV	NPV	Youden Index
PNI	0.816(0.769-0.857)	≤42	92.3	44.9	1.7	0.2	57.5	87.8	0.528

Prognostic nutritional index (PNI), AUC: Area under the curve, LR: likelihood ratio, PPV: Positive predictive value, NPV: Negative predictive value

Table 3. Examination of the relationship between age, gender, clinical features, laboratory characteristics, and PNI with mortality by logistic regression analysis

	Odds Ratio	%95 Confidence interval	p value
Age	1.037	0.988-1.089	0.143
Gender Woman Man	1.230	0.559-2,.06	0.606
Pulse rate (bpm)	1.019	0.994-1.044	0.139
SpO_2 (%)	0.898	0.837-0.964	0.003
Temperature (°C)	1.534	0.948-2.481	0.081
White blood cell (10^3u/L)	1.631	1.167-2.279	0.004
Neutrophil (10^3/mm^3)	0.662	0.466-0.940	0.021
Urea(mg/dL)	1.006	0.996-1.015	0.243
Congestive heart failure	1.608	0.512-5.052	0.416
Chronic renal failure	2.630	0.719-9.621	0.144
PNI	0.841	0.774-0.914	0.001

Prognostic nutritional index (PNI)

DISCUSSION

In this study, the prognostic significance of PNI in geriatric COVID-19 patients was evaluated, and it was found that low PNI values were significantly associated withhigher in-hospital mortality rates. These results suggest that PNI may be an important determinant for COVID-19 prognosis in elderly patients.

As the number of individuals infected with COVID-19 increases, so does the potential burden on healthcare systems. For all these reasons, the development of markers that can predict the prognosis of the disease, as well as early diagnosis, is becoming increasingly important. Identifying laboratory tests that contribute to the diagnosis and follow-up of COVID-19 patients is essential not only for assisting in the diagnostic process but also for classifying patients in terms of disease severity and mortality risk.

In the early stages of the COVID-19 pandemic, healthcare systems around the world were pushed to the brink of collapse, and researchers examined various prognostic models for this purpose.[14] PNI is one of them. Previous studies in the literature have shown that PNI is an important factor affecting the prognosis of various diseases. In a study conducted in China with 122 patients, it was found that COVID-19 patients with severe forms had lower PNI values than those with nonsevere forms.[15] In a meta-analysis covering 13 studies with data from 4204 patients, it was emphasized that low PNI values could be a useful prognostic tool in COVID-19 patients.[16] In a study by Wang and colleagues, COVID-19 patients were divided into critical and non-critical groups and various characteristics were compared, with lower PNI values found in the critical group, and PNI was emphasized as an independent factor predicting critical patients.[17] In a study involving COVID-19 patients in Wuhan, the primary outcome was defined as in-hospital mortality, and although lower PNI, advanced age, and neutrophil-to-lymphocyte ratio were detected in the non-survivor group, logistic regression analysis concluded that PNI was the only useful parameter.[18] The two components of PNI, lymphocytes and albumin, have been shown to be associated with poor prognosis in COVID-19.[19,20] However, studies in the literature have shown that the PNI formulation provides more successful prognostic predictions.

This study's results support the existing knowledge on the prognostic importance of PNI in geriatric COVID-19 patients and provide a significant basis for adopting more individualized approaches in managing these patients.

One of the important results of this study was that the albumin levels of the non-survivor group were lower than those of the survivor group. Previous studies have shown that hypoalbuminemia can be seen in patients with COVID-19 infection. Although the pathophysiology of this event has not been clearly explained, it has been thought that it may develop secondary to increased capillary permeability, decreased protein synthesis, decreased half-life of serum albumin, decreased serum albumin total mass, increased volume of distribution, and increased expression of vascular endothelial growth factor.[21]

Another important result of this study is that the non-survivor group had statistically significant congestive heart failure and chronic kidney failure compared to the survivor group. When the literature is examined, it has been reported that comobirdity is associated with a poor prognosis in COVID-19 patients, and that the rate of having at least one comorbidity in patients with a poor prognosis may exceed 70%.[2]

Finally, the logistic regression analysis of the data obtained in the study shows that not only the PNI, but also the white blood cell, neutrophil count and sPO_2 values were statistically significant. As a matter of fact, while there are lower sPO_2 values in patients who lost their lives due to COVID-19 in the literature, they have higher white blood cell and neutrophil count values.[19] In the light of this information, our study was found to be compatible with the literature.

However, this study has some limitations. Firstly, due to its retrospective nature, there may be a lack of some crucial data and the possibility of observation bias. Secondly, because it is a single-center study, the generalizability of the results to geriatric COVID-19 patients in different geographies and healthcare systems is limited. In the future, multicenter and prospective studies can further strengthen our knowledge on this subject.

CONCLUSION

This study reveals the prognostic importance of PNI in geriatric COVID-19 patients. Low PNI values have been found to be associated with in-hospital mortality rates. The use of PNI can be considered an important tool for assessing the prognosis of elderly patients with COVID-19 and developing more individualized treatment strategies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Şişli Hamidiye Etfal Ethics Committee (Date: 04.04.2023, Decision no: 2289).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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